

Claims

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1. A sol-gel coating material comprising
- 5 (A) an acrylate copolymer solution comprising at least one acrylate copolymer (A1) preparable by copolymerizing at least the following monomers:
- 10 a1) at least one (meth)acrylic ester which is substantially free of acid groups,
- 15 a2) at least one ethylenically unsaturated monomer which bears at least one hydroxyl group per molecule and is substantially free of acid groups, and
- 20 a3) at least one ethylenically unsaturated monomer which bears per molecule at least one acid group which is convertible into the corresponding acid anion group;
- 25 (B) a sol preparable by hydrolyzing, condensing and complexing
- B1) at least one hydrolyzable metal compound of the general formula I

MR_n (I)

where the variables and the index have the following meaning:

M = aluminum, titanium or zirconium,

R = hydrolyzable groups, hydroxyl groups and nonhydrolyzable groups with the proviso that there is at least one and there are preferably at least two hydrolyzable group(s), and

n = 3 or 4;

B2) at least one hydrolyzable silane of the general formula II

$Si(R^1)_2(R^2)_2$ (II)

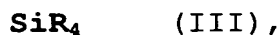
in which the variables R^1 and R^2 have the following meaning:

R^1 = alkyl and/or cycloalkyl radicals
and

R^2 = alkoxy and/or cycloalkoxy radicals;

and

B3) at least one hydrolyzable silane of the
general formula III



where the variable R has the meaning given
above;

with the proviso that the silane (B3) is not a
silane (B2) according to the general formula
II,

and

(C) 0 to 40% by weight, based on the total amount
of coating material, of a stock coating
material, preparable by hydrolyzing and
condensing at least one hydrolyzable silane
(B3) of the general formula III.

2. The sol-gel coating material of claim 1,
characterized in that the radical R^1 is methyl,
ethyl, propyl, isopropyl, n-butyl, sec-butyl,
tert-butyl, pentyl, hexyl, cyclopropyl,
cyclobutyl, cyclopentyl and/or cyclohexyl groups
and the radical R^2 is methoxy, ethoxy, propoxy,
isopropoxy, n-butoxy, sec-butoxy, tert-butoxy,

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pentyloxy, hexyloxy, cyclopropyloxy, cyclobutyloxy, cyclopentyloxy and/or cyclohexyloxy groups.

5 3. The sol-gel coating material of claim 1 or 2, characterized in that the molar ratio of silane (B2) to silane (B3) is 1 : 10 to 1 : 1 and especially 1 : 6 to 1 : 2.

10 4. The sol-gel coating material of one of claims 1 to 3, characterized in that the atomic ratio of metal M to silicon is 1 : 10 to 1 : 1.5 and especially 1 : 6 to 1 : 2.

15 5. The sol-gel coating material of any of claims 1 to 4, characterized in that it is aromatics free.

20 6. The sol-gel coating material of any of claims 1 to 5, characterized in that it comprises, in each case based on its total amount, 1 to 30, preferably 2 to 20 and especially 3 to 15% by weight of the acrylate copolymer solution (A) and 5 to 50, preferably 10 to 40 and especially 15 to 30% by weight of the sol (B) and also up to 94% by weight of at least one suitable additional constituent.

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7. The sol-gel coating material of any of claims 1 to 6, characterized in that, in the general formulae I and II,

5 - the nonhydrolyzable groups R are alkyl groups, especially of 1 to 4 carbon atoms; alkenyl groups, especially of 2 to 4 carbon atoms; alkynyl groups, especially of 2 to 4 carbon atoms; and/or aryl groups, especially of 6 to 10 carbon atoms; and

10 - the hydrolyzable groups R are hydrogen atoms, alkoxy groups, especially of 1 to 20 carbon atoms; alkoxy-substituted alkoxy groups of 3 to 20 carbon atoms; acyloxy groups, especially of 1 to 4 carbon atoms; alkylcarbonyl groups, especially of 2 to 6 carbon atoms.

20 8. The sol-gel coating material of claim 7, characterized in that

25 - the hydrolyzable groups R are methoxy, ethoxy, n-propoxy, i-propoxy, n-butoxy, sec-butoxy, beta-methoxyethoxy, acetoxy, propionyloxy and/or acetyl groups and the

- nonhydrolyzable groups R are methyl, ethyl, propyl, butyl, vinyl, 1-propenyl, 2-propenyl,

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butenyl, acetylenyl, propargyl, phenyl and/or
and naphthyl groups.

5 9. The sol-gel coating material of any of claims 1 to
8, characterized in that the nonhydrolyzable
groups R contain at least one functional group,
especially at least one epoxide group, amino
group, olefinically unsaturated group, mercapto
group and/or isocyanate group and/or their
10 reaction products with further reactive compounds.

15 10. The sol-gel coating material of any of claims 1 to
9, characterized in that complexing is effected
using organic compounds which form chelate
ligands.

20 11. The sol-gel coating material of any of claims 1 to
10, characterized in that it is a sol-gel
clearcoat material.

25 12. The use of the sol-gel coating material of any of
claims 1 to 11 for producing mar-resistant sol-gel
coatings, especially for single-coat or multicoat
paint systems.

13. The use of the sol-gel coating material of claim
12, characterized in that cured single-coat or
multicoat paint systems are concerned.

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14. The use of the sol-gel coating material of claim 12 or 13, characterized in that the paint systems are vehicle original equipment manufacturing coatings, vehicle repair coatings, industrial coatings, including container coatings, plastics coatings and furniture coatings.

15. A process for producing mar-resistant sol-gel coatings on single-coat or multicoat paint systems by

(i) applying a single-coat or multicoat paint system to a primed or unprimed substrate,

(ii) applying a sol-gel coating material atop the single-coat or multicoat paint system, and

(iii) curing the sol-gel coating material,

characterized in that a sol-gel coating material as claimed in any of claims 1 to 11 is used.

16. The process of claim 15, characterized in that the applied sol-gel coating material is cured by irradiation with intermediate IR radiation.

17. The process of claim 15 or 16, characterized in that the single-coat or multicoat paint system has been completely cured.

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18. The process of any of claims 15 to 117,
characterized in that the paint systems are
automotive original equipment manufacturing
coatings, automotive repair coatings, industrial
5 coatings, including coil coatings and container
coatings, plastics coatings and furniture
coatings.

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10 19. Sol-gel coatings preparable from a sol-gel coating
material as claimed in any of claims 1 to 11
and/or by the process as claimed in any of claims
15 to 18.

15 20. Substrates comprising at least one sol-gel coating
as claimed in claim 19.

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